Further, regarding the objection to the drawings, Figure 6 has been amended to change the label "[min]" to "[mm]," Figure 1 has been labeled "PRIOR ART," and the specification has been amended to refer to a stator 1 when referring to Figure 10 in light of the comments noted in the outstanding Office Action. Further, the outstanding Office Action indicates the features recited in Claims 1, 3, 8 and 9 must be shown in the drawings or the features canceled from the claims. Applicants note the feature recited in Claim 1 in which the permanent magnet is in the cavities is shown in Figure 2, for example, as permanent magnet 6 in the cavities 5 (see also page 14, lines 24-25). The subject matter recited in Claim 3 has been amended to recite that the cavities arranged in the q-axis direction extend through to an outer circumferential portion in a radial direction of the rotor. This feature is shown in Figures 2 and 4, for example. Further, regarding the subject matter recited in Claim 8, a new Figure 3B has been added which shows the width in the radial direction of a cavity increasing towards the center in the q-axis direction. It is believed no new matter has been added. The subject matter recited in Claim 9 is believed to be shown in Figure 7, for example. Accordingly, it is respectfully requested the objection to the drawings be withdrawn.

Regarding the rejection of Claim 10 under 35 U.S.C. §112, first paragraph, the specification has been amended to recite that the stator satisfies the claimed relationship (rather than the rotor satisfying the claimed relationship). The stator 1 is clearly shown in Figure 10, for example, and the claimed relationship is shown in Figure 11. Accordingly, it is respectfully requested this rejection also be withdrawn.

Claims 1-3, 10 and 11 stand rejected under 35 U.S.C. §103(a) as unpatentable over Sakai et al. This rejection is respectfully traversed.

The present invention as recited in Claim 1 is directed to a permanent magnet type reluctance electric motor in which the rotor satisfies a relationship of $PL/2\pi RW_{qave} \geqq 130$, where W_{qave} (m) indicates an average thickness of the rotor iron core on an outer side in a

radial direction of the rotor with respect to cavities arranged in a q-axis direction, L(m) indicates a width in a circumferential direction of the cavities, P indicates the number of poles and R(m) indicates the radius of the rotor. Similarly, independent Claim 10 is directed to a permanent magnet type reluctance electric motor in which the rotor satisfies a relationship of $0.45 \leqq W_t/\tau \leqq 0.8$, where τ (m) indicates the pitch of the slot and W_t(m) indicates the width of the teeth.

The present inventors advantageously determined a correlation between the $PL/2\pi RW_{qave}$ dependency of torque and the torque (as shown in Figure 5 and as recited in Claim 1) and a correlation between the W_t/τ dependency of torque and the torque (see Figure 11 and as recited in Claim 10), and determined these claimed ranges are critical and that they produce unexpected results. In more detail, as is clear from Figure 5, when $PL/2\pi RW_{qave} \geqq 130$, a torque having 95% or more of the maximum torque value is obtained, which is higher than that obtained by conventional designing (see page 16, line 27 to page 17, line 4). Further, as shown in Figure 11, a high torque is obtained in a range of $0.45 \leq W_t/\tau \leq 0.8$ (see page 32, lines 7 and 8). Thus, a high torque is obtained, and it is possible to perform a variable speed drive at a high output in a wide range from a low-speed to a high-speed rotation resulting in unexpected results.

The outstanding Office Action recognizes Sakai et al do not teach or suggest the claimed ranges and states it would have been obvious to form a rotor which satisfies the claimed relationship. However, Applicants note the claimed relationship of the present invention are shown to be critical and to produce unexpected results such as significantly enhancing the performance of the electric motor.

Accordingly, it is respectfully submitted independent Claims 1 and 10 and each of the claims depending therefrom are allowable.

Claims 4-7 stand rejected under 35 U.S.C. §103(a) as unpatentable over Uchida et al. This rejection is respectfully traversed.

Similar arguments apply to independent Claims 4 and 6. In more detail, independent Claim 4 is directed to a permanent magnet type reluctance electric motor in which the rotor satisfies a relationship of $W_{dmin}P/2\pi R \geqq 65$, where W_{dmin} (m) indicates a minimum distance between a cavity arranged in the q-axis direction and a permanent magnet, P indicates the number of poles and R(m) indicates the radius of the rotor. Similarly, independent Claim 6 is directed to a permanent magnet type electric motor in which the rotor satisfies the relationship of $110 \leqq W_{dave}P/2\pi R \leqq 150$, where W_{dave} (m) indicates an average distance between a cavity arranged in the q-axis direction and a permanent magnet, P indicates the number of poles and R (m) indicates the radius of the rotor.

For example, Figure 8 illustrates the claimed relationship recited in Claim 4 and Figure 9 illustrates the claimed relationship recited in Claim 6. As shown in Figure 8, when a relationship of $PW_{dmin}/2\pi R \geq 65$ is satisfied, 95% or higher the maximum of torque is obtained, which is higher than that obtained with conventional designing (see page 22, line 26 to page 23, line 4). Further, as shown in Figure 9, when a relationship of $110 \leqq W_{dave} P/2\pi R \leqq 150$, is satisfied, 95% or higher of the maximum torque is obtained, which is higher than that obtained with conventional designing (see page 27, lines 1-5). Again, these ranges are critical and produce unexpected results in which a high torque can be obtained and as a result it is possible to perform a variable speed drive at a high output in a wide range from a low-speed to a high-speed rotation.

The outstanding Office Action recognizes Uchida et al also do not teach or suggest the claimed ranges and again cites that it would have been obvious to one of ordinary skill in the art. However, as discussed above, the claimed ranges are critical and produce unexpected

results. Accordingly, it is respectfully submitted independent Claims 4 and 6 and each of the claims depending therefrom are also allowable.

Claims 8 and 9 stand rejected under 35 U.S.C. §103(a) as unpatentable over Sakai et al in view of Sakai. This rejection is respectfully traversed.

Claims 8 and 9 depend on Claim 1, which as discussed above is believed to be allowable. Further, it is respectfully submitted Sakai also do not teach or suggest the claimed ranges. Accordingly, it is respectfully requested this rejection also be withdrawn.

Consequently, in light of the above discussion and in view of the present amendment, the present application is believed to be in condition for allowance and an early and favorable action to that effect is respectfully requested.

Respectfully submitted,

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IN THE SPECIFICATION

Page 2, lines 3-7, please amend the paragraph to read as follows:

--The conventional reluctance electric motor having such a structure as described above does not require a coil for creating a [filed] field magnet in the rotor 10, and thus the rotor 10 can be made of only the rotor iron core 4 having projections and recesses.--

Page 3, lines 20-25, please amend the paragraph to read as follows:

--However, as an electric current increases, the regional magnetic saturation in a projecting portion of the rotor iron core 4, which serves as a magnetic pole, is enlarged [(,] (the projecting section being a section where the magnetic flux easily passes through, and to be called d-axis hereinafter).--

Page 3, line 26, to page 4, line 5, please amend the paragraph to read as follows:

--As a result of this, the magnetic flux which leaks to the recess portion of teeth, which is an in-between of magnetic poles, is increased, [(,] (the recess section being a section where the magnetic flux does not easily pass through, and to be called q-axis hereinafter) and therefore a significant magnetic flux is decreased, thereby lowering the output.--

Page 12, lines 22-24, please amend the paragraph to read as follows:

--[FIG. 3 is an] FIGS. 3A and 3B are cross sectional [view] views showing an example of the structure in detail of a rotor shown in FIG. 2;--

Page 16, lines 22-26, please amend the paragraph to read as follows:

--[FIG. 4] FIG. 5 is a dependency characteristic diagram illustrating a correlation between the torque and $PL/2\pi RW_{qave}$ when an analysis is carried out on a model designed by conditions that the number of poles is 8 and the radius of the rotor 10 is 0.08 [m].--

Page 17, line 26, to page 18, line 6, please amend the paragraph to read as follows:

--With a design having a large value in $PL/2\pi RW_{qave}$, it is considered that there are a great number of poles, the radius is small, W_{qave} [m] indicates the average thickness of the rotor iron core 4 on an outer side in a radial direction of the rotor with respect to cavities 5 arranged in a q-axis direction is small, and the width in a circumferential direction of the cavities 5 is wide.--

Page 19, lines 16-20, please amend the paragraph to read as follows:

--In the above-described embodiment (the structure shown in [FIG. 3] FIG. 3A), it is also possible that the width of the cavities 5 arranged in the q-axis direction are made to increase towards the center of the q-axis direction (see FIG. 3B).--

Page 30, lines 2-10, please amend the paragraph to read as follows:

--FIG. 10 is a cross sectional diagram showing an enlarged view of a part of a [rotor 10] stator 1 in the permanent magnet type reluctance electric motor according to the embodiment of the present invention, and in this figure, similar structural elements to those shown in FIGS. 2 and 3 are designated by the same reference numerals, the description of which will not be repeated here. Thus, only different sections from those already described will now be explained.--

Page 30, lines 11-16, please amend the paragraph to read as follows:

--As shown in FIG. 10, the [rotor 10] stator 1 of the permanent magnet type reluctance electric motor according to this embodiment, is formed to satisfy a relationship of: $0.45 \leqq W_t / \tau \leqq 0.8$, where z [m] indicates the pitch of the slot and W_t [m] indicates the width of the teeth ([rotor] stator iron core teeth width).--

Page 30, lines 17-22, please amend the paragraph to read as follows:

--Next, in the permanent magnet type reluctance electric motor having the above-described embodiment according to the embodiment of the present invention, the [rotor] stator 1 satisfies a relationship of: $0.45 \leqq W_t / \tau \leqq 0.8$. With this structure, a high torque can be obtained.--

Page 31, lines 14-23, please amend the paragraph to read as follows:

--That is, the teeth width W_t becomes narrow, the magnetic saturation occurs at a teeth site, thus increasing the magnetic reluctance of the teeth. Therefore, the magnetic reluctance with regard to the current becomes to have a high magnetic reluctance ratio occupying the [rotor] stator 1, and the difference in the magnetic reluctance within the [rotor] stator 1 becomes small with relative to each other. As a result, the reluctance torque becomes small, and the output is decreased.--

Page 32, lines 14-24, please amend the paragraph to read as follows:

--As described above, in the permanent magnet type reluctance electric motor according to the embodiment of the present invention, the [rotor 10] stator 1 of the permanent magnet type reluctance electric motor according to this embodiment, is formed to satisfy a relationship of : $0.45 \leqq W_t/\tau \leqq 0.8$, where τ [m] indicates the pitch of the slot and W_t [m] indicates the width of the teeth ([rotor] stator iron core teeth width). Thus, it becomes possible with a small size to perform a variable speed drive at a high output in a wide range from a low-speed to a high-speed rotation.--

IN THE CLAIMS

--1. (Amended) A permanent magnet type reluctance electric motor comprising:

a stator including a stator iron core and having armature coils placed inside slots; and

a rotor provided with a plurality of magnetic barriers formed by cavities and placed on an inner side of the stator in such a manner that sections where a magnetic flux can easily pass (d-axis) and sections where a magnetic flux cannot easily pass (q-axis) are alternately formed, and made of a rotor iron core having permanent magnets in cavities, [characterized in that:]

wherein the rotor satisfies a relationship of:

$PL/2\pi RW_{qave} \geqq 130$,

where [W_{qave} [m]] W_{qave} (m) indicates an average thickness of the rotor iron core on an outer side in a radial direction of the rotor with respect to cavities arranged in a q-axis direction, [L [m]] L (m) indicates a width in a circumferential direction of the cavities, P indicates the number of poles and [R [m]] R (m) indicates the radius of the rotor.

3. (Amended) A permanent magnet type reluctance electric motor according to claim 1, wherein the cavities arranged in the q-axis direction [are made to go] extend through to an outer circumferential portion in a radial direction of the rotor.

4. (Amended) A permanent magnet type reluctance electric motor comprising:

a stator including a stator iron core and having armature coils placed inside slots; and

a rotor provided with a plurality of magnetic barriers formed by cavities and placed on an inner side of the stator in such a manner that sections where a magnetic flux can easily pass (d-axis) and sections where a magnetic flux cannot easily pass (q-axis) are alternately formed, and made of a rotor iron core having permanent magnets in cavities, [characterized in that]

wherein the rotor satisfies a relationship of:

$W_{dmin}P/2\pi R \geqq 65$,

where [W_{dmin} [m]] W_{dmin} (m) indicates a minimum distance between a cavity arranged in the q-axis direction and a permanent magnet, P indicates the number of poles and [R [m]] R (m) indicates the radius of the rotor.

6. (Amended) A permanent magnet type reluctance electric motor comprising:

a stator including a stator iron core and having armature coils placed inside slots; and

a rotor provided with a plurality of magnetic barriers formed by cavities and placed on an inner side of the stator in such a manner that sections where a magnetic flux can easily pass (d-axis) and sections where a magnetic flux cannot easily pass (q-axis) are alternately formed, and made of a rotor iron core having permanent magnets in cavities, [characterized in that]

wherein the rotor satisfies a relationship of:

[$95 \leqq W_{dave}P / 2 \pi R \leqq 160$] $110 \leq W_{dave} P/2\pi R \leq 150$,

where [W_{dave} [m]] W_{dave} (m) indicates an average distance between a cavity arranged in the q-axis direction and a permanent magnet, P indicates the number of poles and [R [m]] R (m) indicates the radius of the rotor.

10. (Amended) A permanent magnet type reluctance electric motor comprising:

a stator including a stator iron core and having armature coils placed inside slots; and

a rotor provided with a plurality of magnetic barriers formed by cavities and placed on an inner side of the stator in such a manner that sections where a magnetic flux can easily pass (d-axis) and sections where a magnetic flux cannot easily pass (q-axis) are alternately formed, and made of a rotor iron core having permanent magnets in cavities, [characterized in that]

wherein the rotor satisfies a relationship of:

$0.45 \leqq W_t/\tau \leqq 0.8$,

where [τ [m]] $\underline{\tau(m)}$ indicates the pitch of the slot and [Wt [m]] $\underline{W_t\,(m)}$ indicates the width of the teeth.--